(12) UK Patent Application (19) GB (11) 2 315 118 (13) A

(43) Date of A Publication 21.01.1998

(21) Application No 9614542.0

(22) Date of Filing 11.07.1996

(71) Applicant(s)
Imperial Chemical Industries PLC

(Incorporated in the United Kingdom)

Imperial Chemical House, Millbank, LONDON, SW1P 3JF, United Kingdom

(72) Inventor(s)
Alan George King

(74) Agent and/or Address for Service
Fitzpatricks
4 West Regent Street, GLASGOW, G2 1RS, United Kingdom

(51) INT CL^6
F42B 3/188

(52) UK CL (Edition P)
F3A AC5D2
U1S S1142 S1820

(56) Documents Cited
EP 0279796 A **US 4690056 A**

(58) Field of Search
UK CL (Edition O) **F3A**
INT CL^6 **F42B 3/18 3/182 3/188**
On-line: WPI, CLAIMS

(54) Electro-explosvie device

(57) An electro-explosive device (EED) comprises a casing containing an electrical initiating element, means for coupling the initiating element to a firing energy source and at least one electrical protective component connected to the coupling means in parallel with the initiating element to provide protection against radio frequency or other unwanted electric currents, at least one of the protective component(s) being mounted on a circuit board 24. The protective component may be a surface mounted component connected to connector elements printed on a composite board firmly fixed in the casing so that the protective component cannot be readily separated from the ignition element, thereby ensuring continuous protection for the EED.

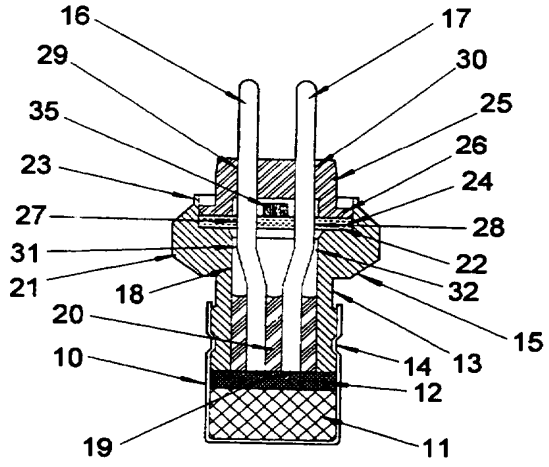

FIGURE 1

GB 2 315 118 A

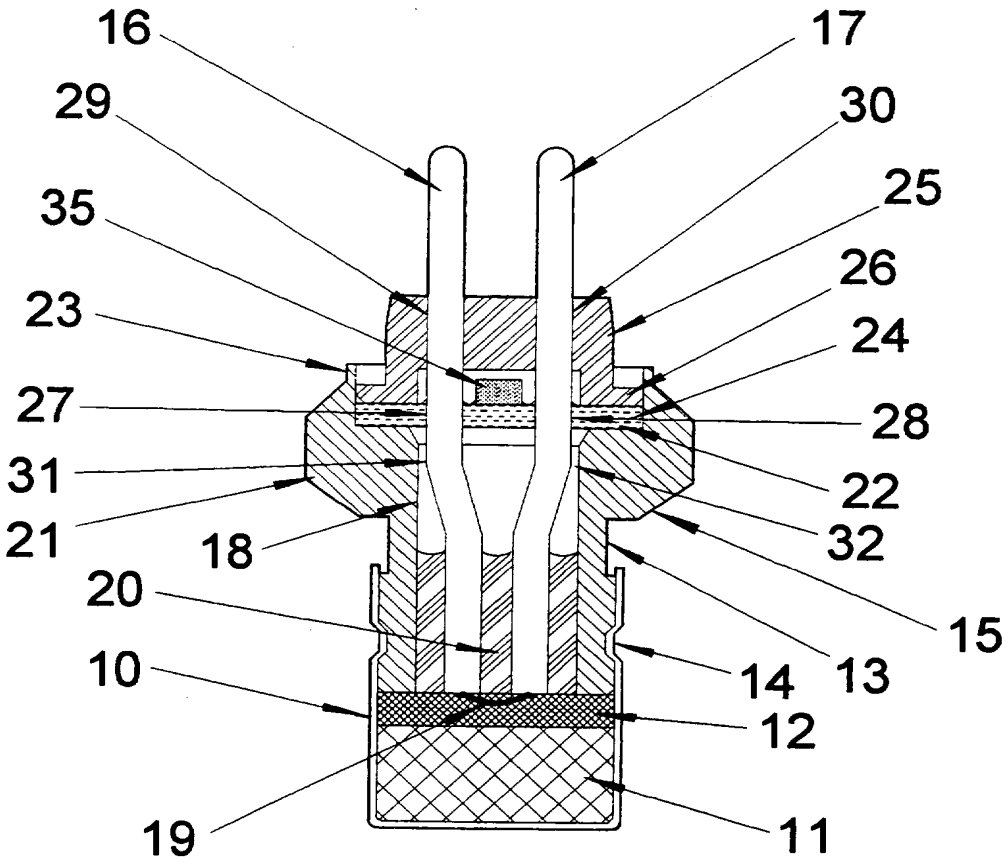

FIGURE 1

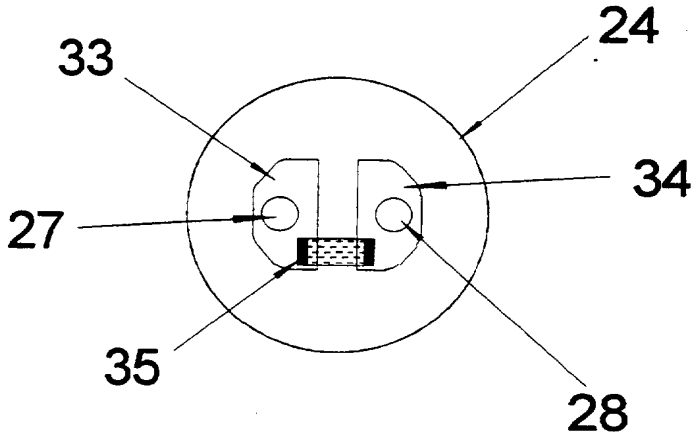

FIGURE 2

2315118

ELECTRO-EXPLOSIVE DEVICE

This invention relates to an electro-explosive device (EED) and more particularly to an electro-explosive device suitable for use in a passive restraint safety system designed to protect vehicle occupants in the event of the vehicle being involved in a collision and to a safety system comprising said ignition device. The term "electro-explosive device" (or EED) herein refers to any electrically initiated explosive or pyrotechnic device. Examples of such devices include electric igniters such as squibs and electric detonators.

Passive restraint systems used in automobiles comprise one or more restraint devices such as inflatable "air-bags" and seat belt tensioners which are activated automatically when the collision occurs to minimise injury to the vehicle occupants. The devices are usually actuated by an explosive device, such as an ignition device which is fired in response to a signal from a collision sensor. The ignition device conveniently comprises an electrical initiating element such as a "hot wire" element designed to ignite an adjacent train of incendiary and gas-generating material, the sensor being operative to effect connection of the initiating element to a source of electrical energy when the collision occurs, thereby initiating a train of events leading to the operation of the safety system. In order to avoid premature ignition of the ignition device it is important to take precautions to prevent the passage of sufficient electrical energy through the initiating element to fire the ignition device before a collision occurs. Sources of electrical energy which are possibly capable of causing premature firing include apparatus which in operation permit the emission of high frequency electromagnetic radiation, such as mobile radios, and portable telephones. It has therefore become common practice to include in the design of passive restraint safety systems means for preventing such high frequency energy from reaching the electrical initiating element.

A passive restraint safety system intended to provide radio frequency protection of the initiating element terminals has been proposed in European Patent specification no. EP 512682. In this system a series inductor element comprising a ferrite bead has been incorporated into the ignition circuit by means of a connector designed for connection to the ignition device. Similar

arrangements incorporating a parallel capacitor have also been proposed. These systems provide adequate protection against the inadvertent pick-up of radio frequency currents in the wires and prevent the possibility of consequent ignition of the initiating element when the protective device remains connected to the ignition device. However, a hazardous condition exists when the connector becomes separated from the ignition device during maintenance or for other reasons. This problem may be overcome by incorporating the protective element permanently in a casing with the initiating element. Ferrite inductor elements have been incorporated in this manner but capacitors have not hitherto been incorporated reliably.

An object of this invention is to provide an improved EED which will improve the safety of passive restraint safety systems.

In accordance with the present invention an EED comprises a casing having securely located therein an electrical initiating element, means for coupling said initiating element to a source of electrical energy for firing said EED and at least one electrical protective component electrically connected to the coupling means in parallel with the initiating element to provide protection against radio frequency or other unwanted electric currents, at least one of said protective component(s) being mounted on a circuit board.

The protective components are fixed in the casing in such manner that they cannot be readily separated from the ignition element. For this purpose electrical connections between the component(s) and the coupling means should preferably be welded or soldered metal connections or sprung metal contacts.

The electrical protective component or components will be adapted to attenuate any radio frequency or other unwanted energy before such energy reaches the initiating element. Appropriate components may comprise for example capacitors or ferrite inductor elements giving protection against radio frequency energy and/or voltage limiting devices giving protective against extraneous transient voltages of short duration.

The coupling means conveniently comprises a pair of conductor leads respectively connected to terminals of the initiating element and trained through an opening in the casing for connection to

the energy source.

The circuit board may be a composite board of the kind typically used for printed electrical circuits and the protective components are conveniently surface mountable components. In a preferred EED the circuit board is formed as a flat disc located as a close fit inside the casing, the disc having one or more, preferably two, holes extending through the disc through which conductor leads from the initiator are trained. Two separate metal connectors are printed or otherwise fixed to the board adjacent to the holes. One of the connectors is connected to each conductor lead, and a protective component is connected across the connectors. Advantageously the casing may be formed with an internal shoulder providing a seat on which the peripheral portion of the circuit board rests. A closure for example a nylon plug may be firmly fixed in the mouth of the casing for example by crimping the casing around the plug, the plug advantageously having a length such that the plug firmly contacts the upper surface of the peripheral surface of the disc and grips the disc firmly between the plug and the shoulder of the casing.

The initiating element may be a bridgewire which, in use, is disposed in ignition relationship with a primary charge of heat ignitable material, advantageously also contained in the casing. The heat ignitable charge may be in communication with one or more secondary or base charges of incendiary material, the combined charges forming an igniferous train which in use can ignite gas-generating material. Thus the initiating element and the charge or charges in ignition relationship therewith may constitute a conventional electrical igniter (electric squib) as used conventionally to ignite a charge of gas-generant to inflate the air-bag of the safety system. Typical primary heat-ignitable charges comprise lead styphnate or barium styphnate and typical secondary charges comprise potassium perchlorate in combination with one or more metals, for example, zirconium, titanium and boron.

The initiating element will typically, have a resistance of 1-3 ohms, and the parallel capacitor a value of 0.1-100 nanofarads, the preferred value being around 1nF to achieve effective performance with minimum physical size.

From a further aspect the invention comprises a vehicle occupant passive restraint safety system comprising a central control unit having two output terminals, said control unit being adapted to

provide electrical energy to said output terminals in response to an appropriate signal from a vehicle collision sensor; and

an EED of the invention in operative association with an igniferous train comprising gas-generating material adapted to actuate a passive restraint safety device, the initiating element of said EED being coupled to said output terminals to receive energy from said output terminals, and the said electrical protected component(s) of the EED being coupled to the said output terminals in parallel with the initiating element.

The invention is further illustrated by the specific embodiment which is hereinafter described by way of Example with reference to the accompanying diagrammatical drawings wherein

Fig 1 is a longitudinal medial cross-section of an electric igniter for an air-bag; and

Fig 2 is a plan view of a circuit board included in the igniter of Fig 1.

The igniter shown in Fig 1 comprises a thin-walled tubular casing 10 of circular cross-section which is blind at one end, the blind end containing a pressed base charge of incendiary material 11 and an overlying ignition charge 12 of heat ignitable pyrotechnic material. The other end, or mouth end of the casing 10 is closed with a header assembly 13 which is firmly fixed in the casing by a circumferential hermetic crimp seal formed by swaging the casing end into a cannelure 14 in a tubular metal body member 15 of the header assembly 13. The header assembly 13 comprises the body member 15 of circular cross-section and a pair of conductor lead wires 16 and 17 which extend through a central bore 18 in the body member 15, the ends of the conductor wires being electrically connected respectively to the ends of a bridgewire 19 which is immersed in the ignition charge 12. The conductor wires 16 and 17 are spatially separated and located in the bore 18 by a glass plug 20 which forms a glass to metal seal around the wires 16 and 17 and around the surface of the bore 18.

The body member 15 has a thick end portion 21 which is stepped internally to provide an internal shoulder 22 and a terminal annulus 23. A circular printed circuit board 24 is transversably positioned in the bore 18 within the annulus 23, a peripheral portion thereof being seated on the

shoulder 22. A locating element 25 moulded from insulating plastic material and formed with a circumferential flange 26 at one end is positioned within the annulus 23 over the circuit board 24, the peripheral portion of the circuit board 24 being firmly gripped between the flange 26 and the shoulder 22. The annulus 23 is swaged around the flange 26 to retain the locating element 25 and the circuit board 24 firmly in the body member 15. The circuit board 24 is provided with holes 27 and 28 and the locating element 25 is provided with holes 29 and 30 through which holes the conductor wires 16 and 17 extend outside the closed casing 10 for connection to an electrical energy source for firing the igniter. The wires 16 and 17 fit tightly in the holes 29 and 30, the locating element thereby providing a moisture proof seal between the wires 16 and 17 and the body member 15. The holes 27, 28, 29, 30, are positioned so that the wires 16 and 17 are located sufficiently close to the body member 15 to provide spark discharge gaps 31 and 32 for the safe discharge of any electrostatic charge on the wires 16 and 17.

The igniter is assembled by first pressing the charge 11 into the blind end of the casing 10 and loading the charge 12 loosely packed over the pressed charge 11. The header assembly 13 is then pressed into the casing, the pressing pressure being sufficient to immerse the bridgewire 19 in the charge 12 and consolidate the charge 12 in the casing 10. The casing 10 is then crimped around the body member 15 to complete the igniter assembly.

In use, the passage of electric current through the conductor wires 16 and 17 causes the bridgewire to heat and ignite the ignition charge 12 and the incendiary charge 11 which can then ignite a gas-generating charge to operate a vehicle occupant restraint safety system.

Referring to Fig 2 the circuit board 24 has two separate connectors 33 and 34 printed on its upper surface around the holes 27 and 28, and connected to the conductor wires 16 and 17 by soldering a connector respectively to each of the wires. A capacitor 35 is connected across the connectors to provide an electrical circuit between the wires 16 and 17 through the capacitor 35 in parallel to the bridgewire 19. The capacitor is effective to prevent extraneous radio frequency energy reaching the bridgewire and prematurely firing the igniter.

CLAIMS

1. An electro-explosive device comprising a casing having securely located therein an electrical initiating element, means for coupling said initiating element to a source of electrical energy for firing said electro-explosive device and at least one electrical protective component electrically connected in parallel across said initiating element to provide protection against radio frequency or other unwanted electric currents, at least one of said protective component(s) being mounted on a circuit board.

2. A device as claimed in claim 1 wherein the electrical connections between the electrical protective component(s) and the initiating element are welded or soldered connections or sprung metal contacts.

3. A device as claimed in claim 1 or claim 2 wherein the electrical protective components comprise at least one capacitor, ferrite inductor element or voltage limiting device.

4. A device as claimed in any one of claims 1 to 3 wherein at least one protective component is a surface mountable component connected to connectors fixed on the circuit board.

5. A device as claimed in any one of claims 1 to 4 wherein the coupling means comprises a pair of conductor leads and the circuit board has two separate connectors fixed thereon, each connector being connected to one of the conductor leads and at least one protective component being connected across the connectors.

6. A device as claimed in any one of claims 1 to 5 wherein the circuit board is a printed circuit board having connectors printed thereon.

7. A device as claimed in any one of claims 1 to 6 wherein the circuit board is in the form a flat disc having one or more holes extending through the disc, and the coupling means comprises a pair of conductor leads extending through said holes.

8. A device as claimed in any one of claims 1 to 7 wherein the casing is formed with an

internal shoulder on which a peripheral portion of the circuit board rests, a closure plug firmly is fixed in said casing, and the said peripheral portion of the circuit board is gripped between said plug and said shoulder.

9. A device as claimed in any one of claims 1 to 9 wherein the said initiating element is a bridgewire.

10. A device as claimed in claim 9 wherein the bridgewire is disposed in said casing in ignition relationship with a primary charge of heat ignitable material, and optionally a base charge of incendiary material.

11. A device as claimed in claim 10 wherein the initiating element and the charge(s) in ignition relationship therewith constitute a conventional electrical igniter.

12. A device as claimed in any one of claims 1 to 11 wherein the initiating element has a resistance within the range 1 to 3 ohms and the electrical protective component comprises a capacitor having a value in the range from 0.1 to 100 nanofarads.

13. An electro-explosive device substantially as described herein with reference to the accompanying drawings.

14. A vehicle occupant passive restraint safety system comprising a central control unit having two output terminals, said control unit being adapted to provide electrical energy to said output terminals in response to an appropriate signal from a vehicle collision sensor; and a device as claimed in any one of claims 1 to 13 in operative association with an igniferous train comprising gas-generating material adapted to actuate a passive restraint safety device, the initiating element of said device being coupled to said output terminals to receive energy from said output terminals, and the said electrical protected component(s) of said device being coupled to the said output terminals in parallel with the initiating element.

The Patent Office

3

Application No: GB 9614542.0 **Examiner:** J L Freeman
Claims searched: 1 to 14 **Date of search:** 23 October 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): F3A

Int Cl (Ed.6): F42B (3/18, 3/182, 3/188)

Other: On-line: WPI, CLAIMS

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	EP 0279796 A	(Nitro Nobel) Col 2 line 61 to col 4 line 6.	1
X	US 4690056	(Dynamit Nobel) Col 1 lines 53 to 61, col 2 lines 43 to 51, & Figs 5a & 5b.	1 - 3 & 6

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.